JAGS Assignment

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4/5/2020

Exercise 8.1

```
data(mtcars)
y = select(mtcars,vs)
s = c( rep("Apple",6) , rep("Blurberry",12) , rep("Cherry",14))
data = data.frame(y=y,s=s)
colnames(data)[1] = c("y")
rownames(data) = c(1:32)
source("DBDA2E-utilities.R")
```

```
##
## *********************************************************************
## Kruschke, J. K. (2015). Doing Bayesian Data Analysis, Second Edition:
## A Tutorial with R, JAGS, and Stan. Academic Press / Elsevier.
## *********************************************************************
```

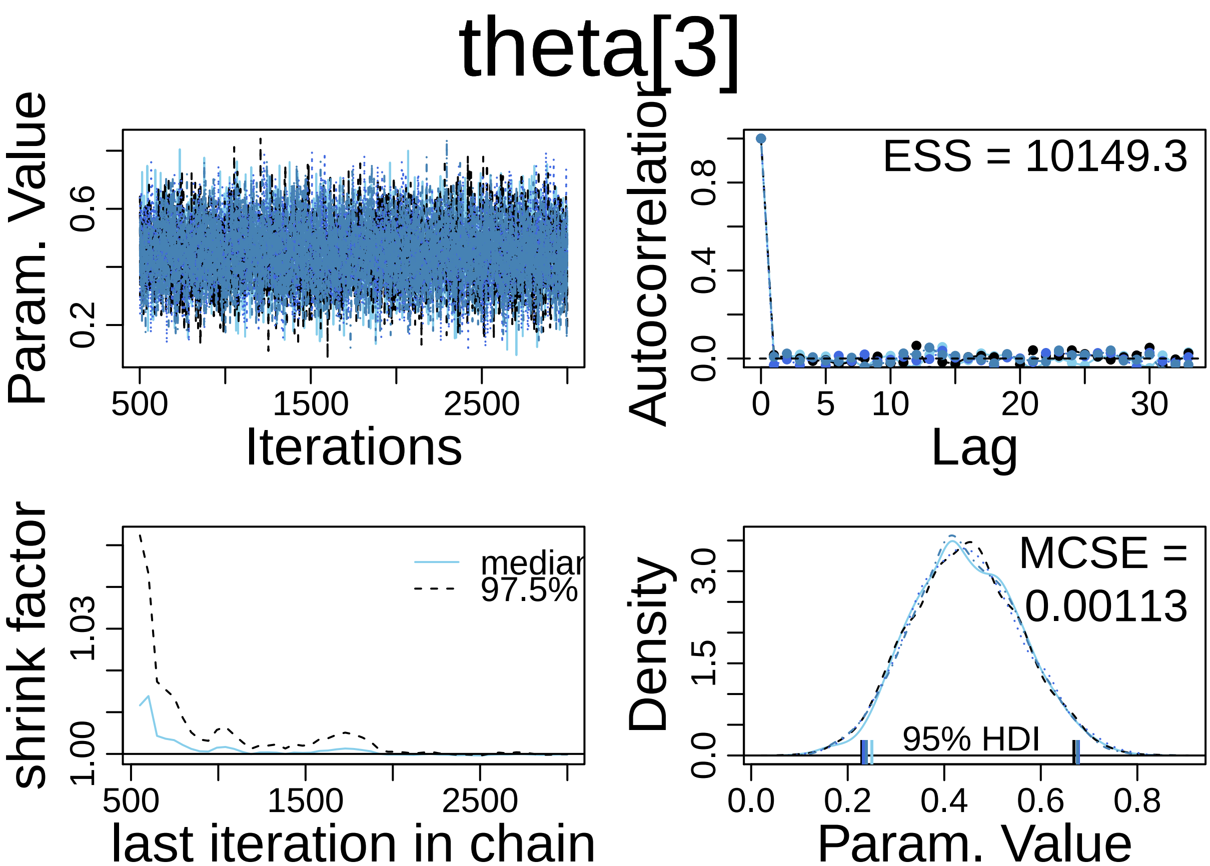
```
source("Jags-Ydich-XnomSsubj-MbernBeta.R")
```

```
##
## *********************************************************************
## Kruschke, J. K. (2015). Doing Bayesian Data Analysis, Second Edition:
## A Tutorial with R, JAGS, and Stan. Academic Press / Elsevier.
## *********************************************************************
```

```
mcmc = genMCMC( data=data , numSavedSteps=10000)
```

```
## Compiling model graph
##    Resolving undeclared variables
##    Allocating nodes
## Graph information:
##    Observed stochastic nodes: 32
##    Unobserved stochastic nodes: 3
##    Total graph size: 70
##
## Initializing model
##
## Burning in the MCMC chain...
## Sampling final MCMC chain...
```

```
parameterNames = varnames(mcmc)
for ( parName in parameterNames ) {
diagMCMC( codaObject=mcmc , parName=parName )
}
smryMCMC( mcmc , compVal=NULL , compValDiff=0.0 )
```




```
##                        Mean       Median       Mode     ESS HDImass
## theta[1]          0.501050655  0.500110989 0.46790615 10000.0    0.95
## theta[2]          0.438892850  0.436264470 0.43227053 11164.7    0.95
## theta[3]          0.445870084  0.442474922 0.41903284 10000.0    0.95
## theta[1]-theta[2]  0.062157804  0.061994723 0.09175565 10000.0    0.95
## theta[1]-theta[3]  0.055180571  0.059516286 0.08928313 10000.0    0.95
## theta[2]-theta[3] -0.006977234 -0.008168533 0.01635828 10000.0    0.95
##                      HDIlow   HDIhigh CompVal PcntGtCompVal ROPElow ROPEhigh
## theta[1]          0.2150179 0.7894756      NA            NA      NA       NA
## theta[2]          0.2150478 0.6748909      NA            NA      NA       NA
## theta[3]          0.2368439 0.6749915      NA            NA      NA       NA
## theta[1]-theta[2] -0.3291888 0.4201468       0         62.39      NA       NA
## theta[1]-theta[3] -0.3031115 0.4219962       0         61.62      NA       NA
## theta[2]-theta[3] -0.3164877 0.3276956       0         48.10      NA       NA
##                   PcntLtROPE PcntInROPE PcntGtROPE
## theta[1]                  NA         NA         NA
## theta[2]                  NA         NA         NA
## theta[3]                  NA         NA         NA
## theta[1]-theta[2]         NA         NA         NA
## theta[1]-theta[3]         NA         NA         NA
## theta[2]-theta[3]         NA         NA         NA
```

```
##                        Mean       Median       Mode     ESS HDImass
## theta[1]          0.501050655  0.500110989 0.46790615 10000.0    0.95
## theta[2]          0.438892850  0.436264470 0.43227053 11164.7    0.95
## theta[3]          0.445870084  0.442474922 0.41903284 10000.0    0.95
## theta[1]-theta[2]  0.062157804  0.061994723 0.09175565 10000.0    0.95
```

```
## theta[1]-theta[3]  0.055180571  0.059516286 0.08928313 10000.0    0.95
## theta[2]-theta[3] -0.006977234 -0.008168533 0.01635828 10000.0    0.95
##                      HDIlow   HDIhigh CompVal PcntGtCompVal ROPElow ROPEhigh
## theta[1]           0.2150179 0.7894756      NA            NA      NA       NA
## theta[2]           0.2150478 0.6748909      NA            NA      NA       NA
## theta[3]           0.2368439 0.6749915      NA            NA      NA       NA
## theta[1]-theta[2] -0.3291888 0.4201468       0         62.39      NA       NA
## theta[1]-theta[3] -0.3031115 0.4219962       0         61.62      NA       NA
## theta[2]-theta[3] -0.3164877 0.3276956       0         48.10      NA       NA
##                   PcntLtROPE PcntInROPE PcntGtROPE
## theta[1]                  NA         NA         NA
## theta[2]                  NA         NA         NA
## theta[3]                  NA         NA         NA
## theta[1]-theta[2]         NA         NA         NA
## theta[1]-theta[3]         NA         NA         NA
## theta[2]-theta[3]         NA         NA         NA
```

```
plotMCMC( mcmc, data=data , compVal=NULL , compValDiff=0.0 )
```

Looking at the diagonal panels, we see that the HDI for theta[1] is wider than the HDI for theta[2], and the MCSE for theta[2] is wider than the MCSE for theta[3], because the data for theta[1] are far fewer than the data for theta[2].

Exercise 8.2

```
smryMCMC( mcmc , compVal=0.5 , rope=c(0.45,0.55) ,compValDiff=0.0 , ropeDiff = c(-0.05,0.05) )
```

```
##                           Mean       Median       Mode     ESS HDImass
## theta[1]           0.501050655  0.500110989 0.46790615 10000.0    0.95
## theta[2]           0.438892850  0.436264470 0.43227053 11164.7    0.95
## theta[3]           0.445870084  0.442474922 0.41903284 10000.0    0.95
## theta[1]-theta[2]  0.062157804  0.061994723 0.09175565 10000.0    0.95
## theta[1]-theta[3]  0.055180571  0.059516286 0.08928313 10000.0    0.95
## theta[2]-theta[3] -0.006977234 -0.008168533 0.01635828 10000.0    0.95
##                      HDIlow   HDIhigh CompVal PcntGtCompVal ROPElow ROPEhigh
## theta[1]           0.2150179 0.7894756     0.5         50.04    0.45     0.55
## theta[2]           0.2150478 0.6748909     0.5         30.60    0.45     0.55
## theta[3]           0.2368439 0.6749915     0.5         31.52    0.45     0.55
## theta[1]-theta[2] -0.3291888 0.4201468     0.0         62.39   -0.05     0.05
## theta[1]-theta[3] -0.3031115 0.4219962     0.0         61.62   -0.05     0.05
## theta[2]-theta[3] -0.3164877 0.3276956     0.0         48.10   -0.05     0.05
##                   PcntLtROPE PcntInROPE PcntGtROPE
## theta[1]               37.66      24.17      38.17
## theta[2]               54.52      27.16      18.32
## theta[3]               52.78      28.87      18.35
## theta[1]-theta[2]      28.44      19.02      52.54
## theta[1]-theta[3]      29.68      18.72      51.60
## theta[2]-theta[3]      40.52      23.32      36.16
```

```
##                           Mean       Median       Mode     ESS HDImass
## theta[1]           0.501050655  0.500110989 0.46790615 10000.0    0.95
## theta[2]           0.438892850  0.436264470 0.43227053 11164.7    0.95
## theta[3]           0.445870084  0.442474922 0.41903284 10000.0    0.95
## theta[1]-theta[2]  0.062157804  0.061994723 0.09175565 10000.0    0.95
## theta[1]-theta[3]  0.055180571  0.059516286 0.08928313 10000.0    0.95
```

```
## theta[2]-theta[3] -0.006977234 -0.008168533 0.01635828 10000.0    0.95
##                      HDIlow   HDIhigh CompVal PcntGtCompVal ROPElow ROPEhigh
## theta[1]           0.2150179 0.7894756     0.5         50.04    0.45     0.55
## theta[2]           0.2150478 0.6748909     0.5         30.60    0.45     0.55
## theta[3]           0.2368439 0.6749915     0.5         31.52    0.45     0.55
## theta[1]-theta[2] -0.3291888 0.4201468     0.0         62.39   -0.05     0.05
## theta[1]-theta[3] -0.3031115 0.4219962     0.0         61.62   -0.05     0.05
## theta[2]-theta[3] -0.3164877 0.3276956     0.0         48.10   -0.05     0.05
##                   PcntLtROPE PcntInROPE PcntGtROPE
## theta[1]               37.66      24.17      38.17
## theta[2]               54.52      27.16      18.32
## theta[3]               52.78      28.87      18.35
## theta[1]-theta[2]      28.44      19.02      52.54
## theta[1]-theta[3]      29.68      18.72      51.60
## theta[2]-theta[3]      40.52      23.32      36.16
```

Each row represents the parameter or parameter difference. The columns labelled Mean, Median, and Mode are the corresponding values of parameter. The ESS is the effective sample size. The next three columns indicate the probability mass of the HDI, the lower limit of the HDI, and the upper limit. The comparison value is specified in the argument as 0.5. The next column indicates the percentage of the posterior that is greater than the comparison value (PcntGtCompVal). The ROPE columns repeat the specifications in the arguments. The final three columns indicate the percentage of the posterior distribution that is less than the ROPE lower limit, within the ROPE limits, and greater than the ROPE upper limit.

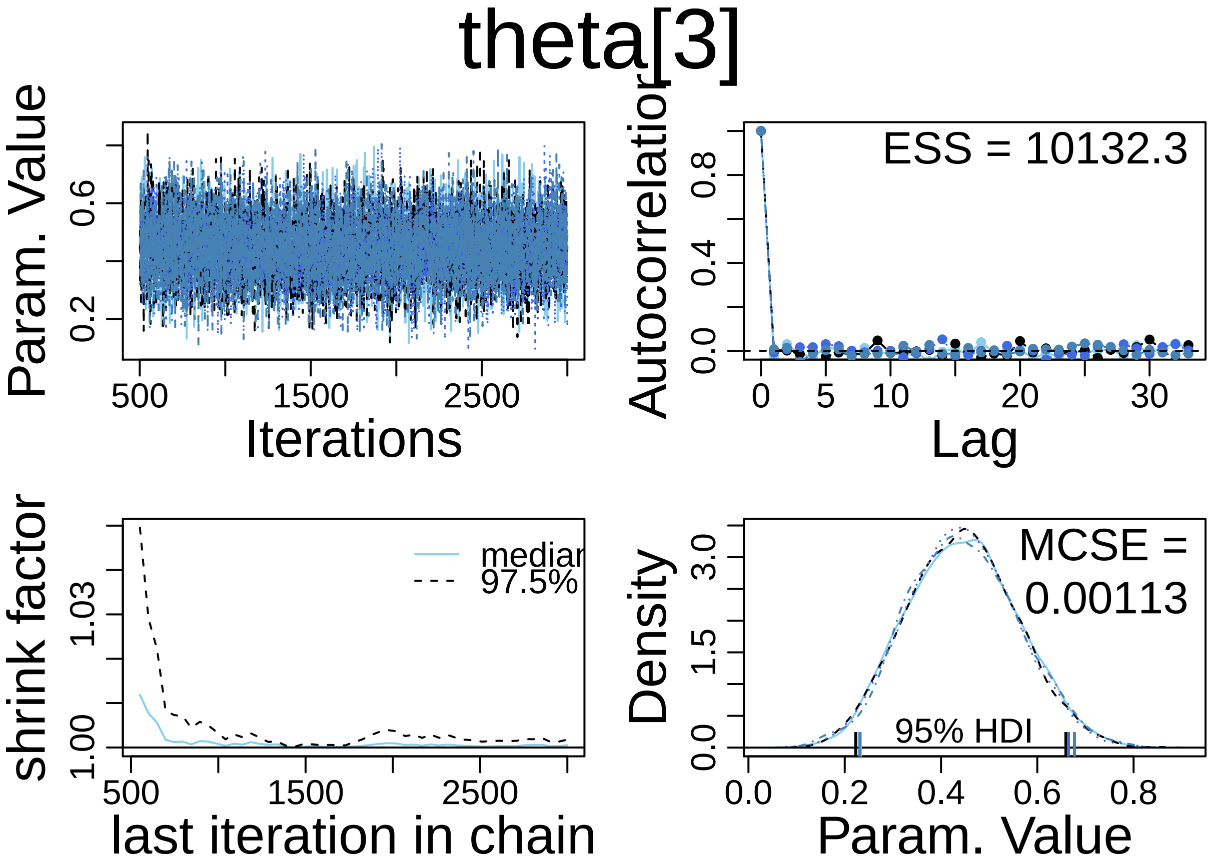
Exercise 8.3

```r
##The first line above specifies the beginning of the filenames for saved information
##The second line above specifies the graphics format for saved graphs

fileNameRoot = "Jags-Ydich-XnomSsubj-MbernBeta-Yiru-"
graphFileType = "eps"

##The MCMC chain is saved in a file named Jags-Ydich-XnomSsubj-MbernBeta-Yiru-Mcmc.Rdata
mcmc = genMCMC( data=data , numSavedSteps=10000 , saveName=fileNameRoot )
```

```
## Compiling model graph
##    Resolving undeclared variables
##    Allocating nodes
## Graph information:
##    Observed stochastic nodes: 32
##    Unobserved stochastic nodes: 3
##    Total graph size: 70
##
## Initializing model
##
## Burning in the MCMC chain...
## Sampling final MCMC chain...
```

```r
##The diagnostic graphs are saved in files named Jags-Ydich-XnomSsubj-MbernBeta-Yiru - Diagtheta.eps
parameterNames = varnames(mcmc)
for ( parName in parameterNames ) {
diagMCMC( codaObject=mcmc , parName=parName , saveName=fileNameRoot , saveType=graphFileType )
}

##The summary information is saved in a file named Jags-Ydich-XnomSsubj-MbernBeta-Yiru-detail.csv
```

```
detail = smryMCMC(mcmc, compVal=0.5, rope=c(0.45,0.55),compValDiff=0.0, ropeDiff = c(-0.05,0.05) ,saveNa
```




```
##                          Mean       Median        Mode     ESS HDImass
## theta[1]           0.498830371  0.498094745  0.46635439  9513.6    0.95
## theta[2]           0.437224701  0.435861151  0.44300529 10000.0    0.95
## theta[3]           0.444421319  0.442593500  0.44206287 10000.0    0.95
## theta[1]-theta[2]  0.061605670  0.063743891  0.09710688 10000.0    0.95
## theta[1]-theta[3]  0.054409051  0.056214744  0.09552906 10000.0    0.95
## theta[2]-theta[3] -0.007196618 -0.008737934 -0.01532545 10000.0    0.95
##                       HDIlow   HDIhigh CompVal PcntGtCompVal ROPElow ROPEhigh
## theta[1]           0.1990578 0.7765479     0.5         49.59    0.45     0.55
## theta[2]           0.2060644 0.6664845     0.5         29.98    0.45     0.55
## theta[3]           0.2311865 0.6694458     0.5         31.05    0.45     0.55
## theta[1]-theta[2] -0.3149150 0.4300225     0.0         62.59   -0.05     0.05
## theta[1]-theta[3] -0.3193779 0.4173329     0.0         60.67   -0.05     0.05
## theta[2]-theta[3] -0.3264288 0.3133183     0.0         47.92   -0.05     0.05
##                   PcntLtROPE PcntInROPE PcntGtROPE
## theta[1]               38.59      23.28      38.13
## theta[2]               54.84      26.76      18.40
## theta[3]               52.54      29.36      18.10
## theta[1]-theta[2]      28.38      18.96      52.66
## theta[1]-theta[3]      30.17      18.94      50.89
## theta[2]-theta[3]      40.25      23.09      36.66
```

```
##The graph of the posterior distribution is saved in a file named Jags-Ydich-XnomSsubj-MbernBeta-Yiru-
plotMCMC( mcmc, data=data , compVal=NULL, compValDiff=0.0, saveName=fileNameRoot , saveType=graphFileTy
```

```
## pdf
##   2
```

Exercise 8.4

(A)

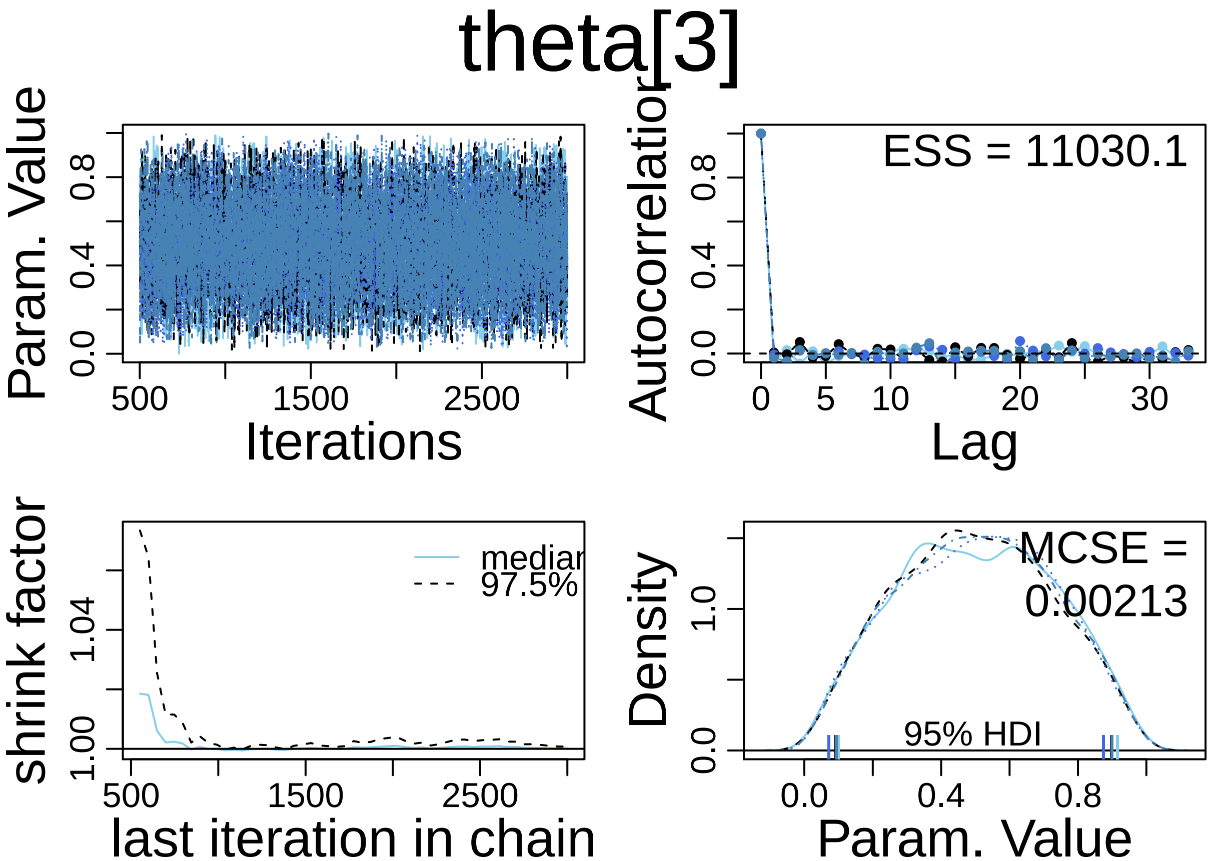
```r
source("Jags-Ydich-XnomSsubj-MbernBeta-8.4.R")
```

```
##
## *********************************************************************
## Kruschke, J. K. (2015). Doing Bayesian Data Analysis, Second Edition:
## A Tutorial with R, JAGS, and Stan. Academic Press / Elsevier.
## *********************************************************************
```

```r
fileNameRoot = "Jags-Ydich-XnomSsubj-MbernBeta-Yiru8.4-"
graphFileType = "eps"

##The MCMC chain is saved in a file named Jags-Ydich-XnomSsubj-MbernBeta-Yiru8.4-Mcmc.Rdata
mcmc = genMCMC_8.4( data=data , numSavedSteps=10000 , saveName=fileNameRoot )
```

```
## Compiling model graph
##    Resolving undeclared variables
##    Allocating nodes
## Graph information:
##    Observed stochastic nodes: 0
##    Unobserved stochastic nodes: 35
##    Total graph size: 70
##
## Initializing model
##
## Burning in the MCMC chain...
## Sampling final MCMC chain...
```

```r
##The diagnostic graphs are saved in files named Jags-Ydich-XnomSsubj-MbernBeta-Yiru8.4 - Diagtheta.eps
parameterNames = varnames(mcmc)
for ( parName in parameterNames ) {
diagMCMC( codaObject=mcmc , parName=parName , saveName=fileNameRoot , saveType=graphFileType )
}

##The summary information is saved in a file named Jags-Ydich-XnomSsubj-MbernBeta-Yiru8.4-detail.csv
detail = smryMCMC(mcmc, compVal=0.5, rope=c(0.45,0.55),compValDiff=0.0, ropeDiff = c(-0.05,0.05) ,saveNa
```




```
##                            Mean       Median        Mode     ESS HDImass
## theta[1]            0.492933818  0.492339150  0.44432969 10000.0    0.95
## theta[2]            0.497094810  0.498600540  0.54241812 10000.0    0.95
## theta[3]            0.500284222  0.501128426  0.46326029 10605.9    0.95
## theta[1]-theta[2] -0.004160992 -0.005562739  0.02443080 10000.0    0.95
## theta[1]-theta[3] -0.007350404 -0.009568616 -0.04312493 10000.0    0.95
## theta[2]-theta[3] -0.003189412 -0.002024378  0.03771356 10000.0    0.95
##                        HDIlow   HDIhigh CompVal PcntGtCompVal ROPElow ROPEhigh
## theta[1]            0.09359287 0.8912644     0.5         48.81    0.45     0.55
## theta[2]            0.07942574 0.8978037     0.5         49.81    0.45     0.55
## theta[3]            0.08814318 0.8990942     0.5         50.11    0.45     0.55
## theta[1]-theta[2] -0.60987098 0.6002949     0.0         49.33   -0.05     0.05
## theta[1]-theta[3] -0.61780055 0.5823259     0.0         48.99   -0.05     0.05
## theta[2]-theta[3] -0.63735826 0.5835598     0.0         49.72   -0.05     0.05
##                   PcntLtROPE PcntInROPE PcntGtROPE
## theta[1]               43.66      15.03      41.31
## theta[2]               42.83      14.92      42.25
## theta[3]               42.29      14.69      43.02
## theta[1]-theta[2]      44.81      11.94      43.25
## theta[1]-theta[3]      44.98      11.83      43.19
## theta[2]-theta[3]      44.33      11.85      43.82
```

```
##The graph of the posterior distribution is saved in a file named Jags-Ydich-XnomSsubj-MbernBeta-Yiru8
plotMCMC( mcmc, data=data , compVal=NULL, compValDiff=0.0, saveName=fileNameRoot , saveType=graphFileTy
```

```
## pdf
##   2
```

(B)

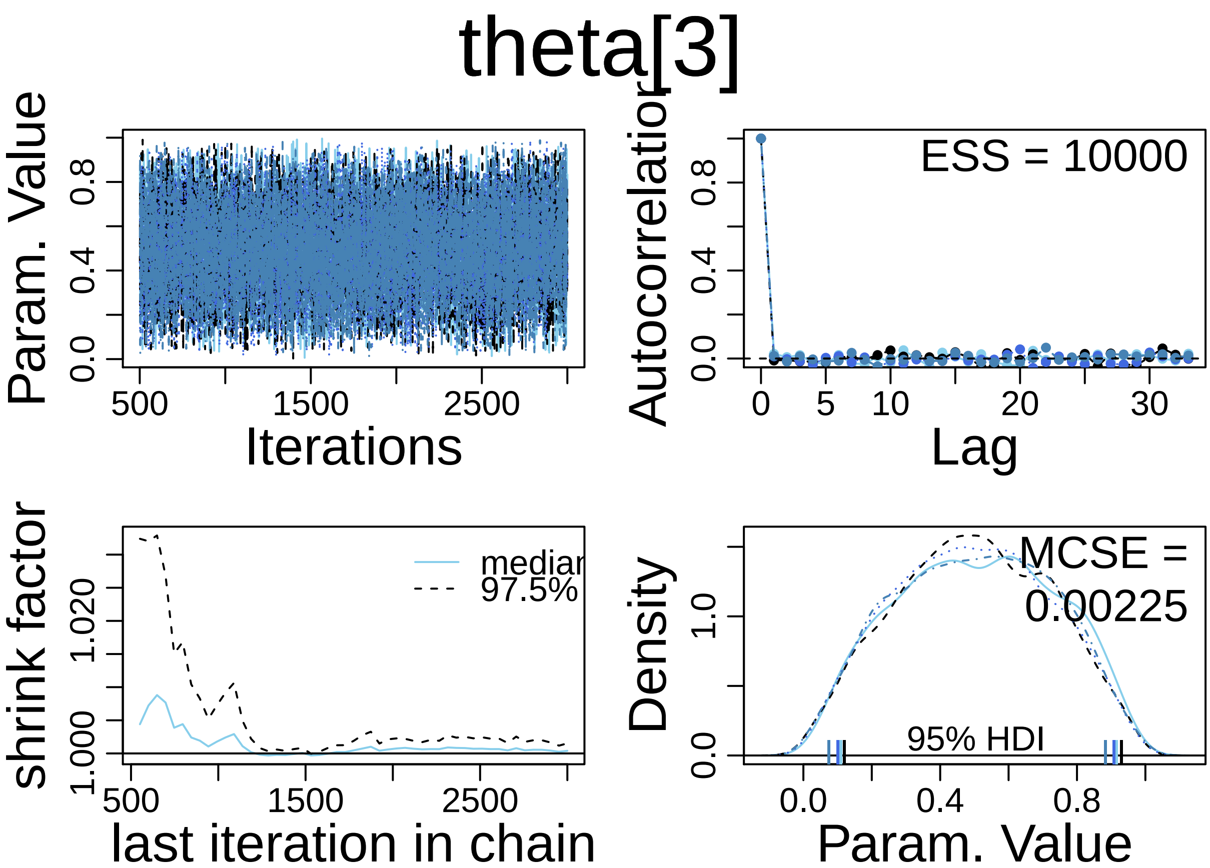
```r
source("Jags-Ydich-XnomSsubj-MbernBeta-b.R")
```

```
##
## *********************************************************************
## Kruschke, J. K. (2015). Doing Bayesian Data Analysis, Second Edition:
## A Tutorial with R, JAGS, and Stan. Academic Press / Elsevier.
## *********************************************************************
```

```r
fileNameRoot = "Jags-Ydich-XnomSsubj-MbernBeta-YiruB-"
graphFileType = "eps"

##The MCMC chain is saved in a file named Jags-Ydich-XnomSsubj-MbernBeta-YiruB-Mcmc.Rdata
mcmc = genMCMC_8.4( data=data , numSavedSteps=10000 , saveName=fileNameRoot )
```

```
## Compiling model graph
##    Resolving undeclared variables
##    Allocating nodes
## Graph information:
##    Observed stochastic nodes: 0
##    Unobserved stochastic nodes: 35
##    Total graph size: 70
##
## Initializing model
##
## Burning in the MCMC chain...
## Sampling final MCMC chain...
```

```r
##The diagnostic graphs are saved in files named Jags-Ydich-XnomSsubj-MbernBeta-YiruB - Diagtheta.eps
parameterNames = varnames(mcmc)
for ( parName in parameterNames ) {
diagMCMC( codaObject=mcmc , parName=parName , saveName=fileNameRoot , saveType=graphFileType )
}

##The summary information is saved in a file named Jags-Ydich-XnomSsubj-MbernBeta-YiruB-detail.csv
detail = smryMCMC(mcmc, compVal=0.5, rope=c(0.45,0.55),compValDiff=0.0, ropeDiff = c(-0.05,0.05) ,saveNa
```




```
##                           Mean       Median         Mode     ESS HDImass
## theta[1]          0.5016132135  0.503419082  0.51047756 10000.0    0.95
## theta[2]          0.5018419905  0.503223807  0.50659554 10000.0    0.95
## theta[3]          0.4993229361  0.498385513  0.45641716 10000.0    0.95
## theta[1]-theta[2] -0.0002287771 -0.001612801 -0.02884904 10366.9    0.95
## theta[1]-theta[3]  0.0022902774  0.004093001  0.04554832 10000.0    0.95
## theta[2]-theta[3]  0.0025190545  0.003014846  0.07624786 10000.0    0.95
##                       HDIlow    HDIhigh CompVal PcntGtCompVal ROPElow ROPEhigh
## theta[1]          0.09045638 0.9018402     0.5         50.61    0.45     0.55
## theta[2]          0.09937614 0.9092413     0.5         50.53    0.45     0.55
## theta[3]          0.09645222 0.9104426     0.5         49.81    0.45     0.55
## theta[1]-theta[2] -0.61092649 0.5908724     0.0         49.79   -0.05     0.05
## theta[1]-theta[3] -0.58376112 0.6342119     0.0         50.49   -0.05     0.05
## theta[2]-theta[3] -0.60396402 0.6170514     0.0         50.37   -0.05     0.05
##                   PcntLtROPE PcntInROPE PcntGtROPE
## theta[1]               41.86      15.46      42.68
## theta[2]               42.02      15.02      42.96
## theta[3]               42.55      14.56      42.89
## theta[1]-theta[2]      44.23      12.09      43.68
## theta[1]-theta[3]      43.85      11.81      44.34
## theta[2]-theta[3]      43.91      11.11      44.98
```

```
##The graph of the posterior distribution is saved in a file named Jags-Ydich-XnomSsubj-MbernBeta-YiruB
plotMCMC( mcmc, data=data , compVal=NULL, compValDiff=0.0, saveName=fileNameRoot , saveType=graphFileTy
```

```
## pdf
##   2
```

The distributions on theta[1], theta[2] and theta[3] look uniform.

(C)

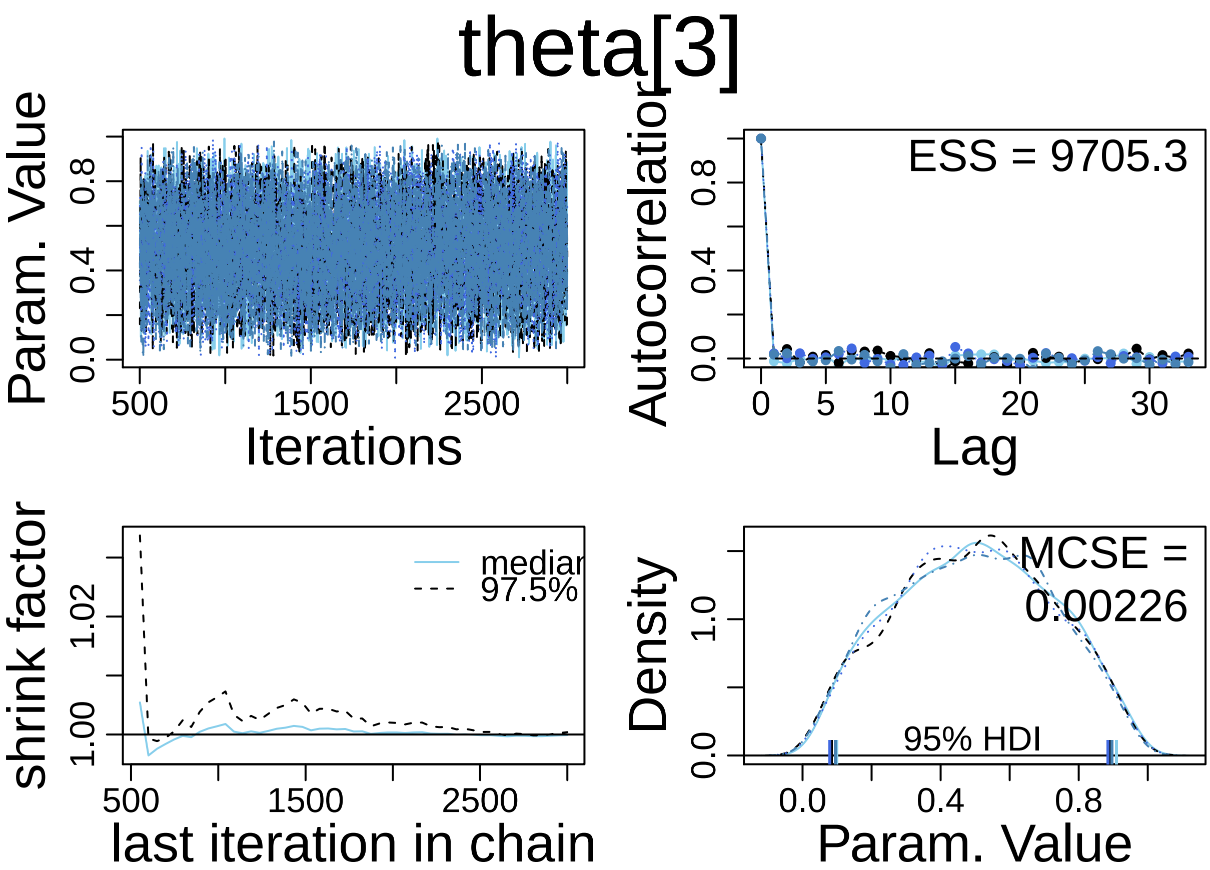
```r
source("Jags-Ydich-XnomSsubj-MbernBeta-c.R")
```

```
##
## *********************************************************************
## Kruschke, J. K. (2015). Doing Bayesian Data Analysis, Second Edition:
## A Tutorial with R, JAGS, and Stan. Academic Press / Elsevier.
## *********************************************************************
```

```r
fileNameRoot = "Jags-Ydich-XnomSsubj-MbernBeta-YiruC-"
graphFileType = "eps"

##The MCMC chain is saved in a file named Jags-Ydich-XnomSsubj-MbernBeta-YiruC-Mcmc.Rdata
mcmc = genMCMC_8.4( data=data , numSavedSteps=10000 , saveName=fileNameRoot )
```

```
## Compiling model graph
##    Resolving undeclared variables
##    Allocating nodes
## Graph information:
##    Observed stochastic nodes: 0
##    Unobserved stochastic nodes: 35
##    Total graph size: 70
##
## Initializing model
##
## Burning in the MCMC chain...
## Sampling final MCMC chain...
```

```r
##The diagnostic graphs are saved in files named Jags-Ydich-XnomSsubj-MbernBeta-YiruC - Diagtheta.eps
parameterNames = varnames(mcmc)
for ( parName in parameterNames ) {
diagMCMC( codaObject=mcmc , parName=parName , saveName=fileNameRoot , saveType=graphFileType )
}

##The summary information is saved in a file named Jags-Ydich-XnomSsubj-MbernBeta-YiruC-detail.csv
detail = smryMCMC(mcmc, compVal=0.5, rope=c(0.45,0.55),compValDiff=0.0, ropeDiff = c(-0.05,0.05) ,saveN
```




```
##                               Mean       Median         Mode     ESS HDImass
## theta[1]          0.5024123575  0.502071002  0.46958592 10352.8    0.95
## theta[2]          0.4963250604  0.498354798  0.55983639 10000.0    0.95
## theta[3]          0.4959867428  0.499375071  0.52246229 10000.0    0.95
## theta[1]-theta[2] 0.0060872971  0.007739527  0.02070282 10000.0    0.95
## theta[1]-theta[3] 0.0064256147  0.012424091  0.06828943  9599.1    0.95
## theta[2]-theta[3] 0.0003383176 -0.005061303 -0.05756460 10000.0    0.95
##                        HDIlow    HDIhigh CompVal PcntGtCompVal ROPElow ROPEhigh
## theta[1]           0.10239081 0.9054275     0.5         50.33    0.45     0.55
## theta[2]           0.09043379 0.9041781     0.5         49.76    0.45     0.55
## theta[3]           0.07856499 0.8865914     0.5         49.91    0.45     0.55
## theta[1]-theta[2] -0.59011956 0.6034972     0.0         50.90   -0.05     0.05
## theta[1]-theta[3] -0.62010338 0.5798768     0.0         51.33   -0.05     0.05
## theta[2]-theta[3] -0.61527133 0.6117624     0.0         49.48   -0.05     0.05
##                   PcntLtROPE PcntInROPE PcntGtROPE
## theta[1]               42.22      14.82      42.96
## theta[2]               43.07      14.83      42.10
## theta[3]               42.69      15.29      42.02
## theta[1]-theta[2]      42.95      12.31      44.74
## theta[1]-theta[3]      43.18      11.61      45.21
## theta[2]-theta[3]      44.37      12.07      43.56
```

```
##The graph of the posterior distribution is saved in a file named Jags-Ydich-XnomSsubj-MbernBeta-YiruC
plotMCMC( mcmc, data=data , compVal=NULL, compValDiff=0.0, saveName=fileNameRoot , saveType=graphFileTy
```

```
## pdf
##   2
```

The distributions on theta[1], theta[2] and theta[3] look uniform.